Claims

1. A method for the attachment, in particular of the liquid-tight and/or gas-tight attachment, of a functional element (210), in particular a fastener element, to a sheet metal part (212), characterized in that the functional element (210) provided with a hollow head part (210a) is pressed against the sheet metal part (212) supported by a die (214) and, with a simultaneous deformation of the hollow head part (210a) and a reforming of the sheet metal part (212) into a reforming space (230) defined by shaped parts (216) of the die, the sheet metal material is formed into an undercut (324) made by deformation of the head part (210a), with the shaped parts being immovably held during the reforming, but being partly lifted out of the die for the removal of the functional element attached to the sheet metal part.

2. A method in accordance with claim 1, characterized in that sheet metal material is brought into engagement with shaped features (231, 233), in particular of groove-like and/or rib-like shape, formed at the end faces of the shaped parts (216) adjacent to the sheet metal material by the press force applied to the functional element (210) during the reforming and in that both the sheet metal part (212) and the region of the head part (210a) above it are deformed thereby to form a security against rotation.

3. A method in accordance with claim 1 or claim 2, characterized in that the sheet metal material is first pressed into the undercut (324)

and preferably brought into engagement with the shaped features forming the security against rotation after the sheet metal part (212) has been at least partly formed into the reforming space (230) by the functional element (210) moved in the direction of a longitudinal axis (222) of the die (214) for the attachment to the sheet metal part and has, in particular, been provided with a collar-like or pot-like recess.

4. A method in accordance with at least one of the preceding claims, characterized in that the sheet metal part (212) is not perforated, i.e. is not pierced, at least in the region of the functional element (210) during its attachment to the sheet metal part (212).

5. A method in accordance with at least one of the claims 1 to 3, characterized in that a pre-pierced sheet metal part is used at the point of the attachment of the hollow head part (210a) of the functional element (210), with the opening being substantially smaller in diameter than the outer diameter of the hollow head part (210a).

6. A method in accordance with at least one of the preceding claims, characterized in that the shaped parts (216) are arranged in segment-like manner around an abutment element (234), which has a dome-like projection (234c), to form the reforming space (230), with the deformation of the cigar-shaped end of the hollow head part (210a) of the functional element being partly carried out by means of this projection (234c).

7. A method in accordance with at least one of the preceding claims, characterized in that the shaped parts (216) are partly lifted out of a conical seat of the die (214) and pivoted radially outwardly to release the component assembly comprising the sheet metal part (212) and the functional element (210).

8. A method in accordance with any one of the preceding claims, characterized in that in the deformation of the hollow head part (210a) of the functional element, this is reformed into two annular folds or annular bulges (320 and 322) spaced from one another by the undercut (324).

9. A method in accordance with claim 8, characterized in that the sheet metal material of the sheet metal part, which protrudes into the undercut (324), is also formed as an annular fold or annular bulge (326).

10. A method in accordance with claim 9, characterized in that the sheet metal material of the sheet metal part, which is reformed into a pot-like shape, surrounds the deformed head part (210a) of the functional element (210).

11. A method in accordance with claim 10, characterized in that the base region of the sheet metal part (212) reformed into a pot-like shape is given a convex shape facing towards the shaft part of the functional element.

12. A method in accordance with claim 10 or claim 11, characterized in that the annular fold (322) of the head part (210a) of the functional element (210) adjacent to the base region is reformed into the corner region of the pot-like recess of the sheet metal part (212) which is formed between the base region and the side wall of the pot-like recess.

13. A die (214), in particular for use in a method in accordance with any one of the preceding claims, characterized by a hollow body (215) having an end face (296) which is provided to support a sheet metal part and which merges via a conically tapering wall (226) into a space (227) receiving an abutment element (234), with the abutment element being spaced from the conically tapering wall to form an annular gap of wedge-shaped cross-section and with the end face of the abutment element adjacent to the end face of the hollow body being set back from the end of the hollow body and having a dome-like projection (234c) surrounded by an annular surface (234d), and further characterized by several, preferably from two to 8, in particular four, shaped parts (216) preferably of substantially the same design which are arranged around a longitudinal axis (222) of the die (214) in the wedge-shaped annular gap and are supported both at the conical wall (226) and at the abutment element (234) as well as by a reforming space (230) which is formed between the shaped parts (216) and the set-back end of the abutment element and into which shaped projections (220) of the shaped parts (216) project.

14. A die in accordance with claim 13, characterized in that each shaped part (216) is arranged in segment-like manner like wedges of

cake around the longitudinal axis (222) of the die (214) around the abutment element (234) of the die (214).

15. A die in accordance with claim 13 or claim 14, characterized in that the shaped projections (220) of the shaped parts (216) have a nose-like shape when cut in a longitudinal plane of the die and are provided in the region of the end face of the shaped parts (216) arranged adjacent to the said end face of the hollow body.

16. A die in accordance with at least one of the claims 13 to 15, characterized in that the shaped parts (216) are provided in their end faces adjacent to the above-named end faces of the hollow body with shaped features, in particular with radially and obliquely extending grooves (331) and noses (333) lying therebetween, which serve in particular for the formation of a security against rotation between a functional element (210) and a sheet metal part (212) when the die (214) is used.

17. A die in accordance with any one of the claims 13 to 16, characterized in that each shaped part (216) is designed to be replaceable.

18. A die in accordance with any one of the claims 13 to 15, characterized in that the abutment element (234) has a cylindrical region adjacent to the shaped parts against which the shaped parts (216) abut.

19. A die in accordance with claim 18, characterized by an elastic resetting element (228) which biases the abutment element (234) in the

direction of the said end face of the hollow body (215) against an annular shoulder of this body.

20. A die in accordance with any one of the preceding claims 13 to 19, characterized in that the shaped parts (216) each have recesses (288) extending in the longitudinal direction of the die (214) into which pins (284) fixedly arranged in the hollow body of the die project and secure the shaped parts (216) against complete removal from the die during their movement for the release of the sheet metal part with an attached functional element.

21. A die in accordance with claim 20, characterized in that the axial length of the recesses (288) less the axial height of the pins (286) at least substantially corresponds to the maximally provided stroke of the shaped parts (216) in the axial direction of the die (214) for the release of the sheet metal part and permits a corresponding pivotal movement of the shaped parts (216).

22. A die in accordance with claim 20 or claim 21, characterized in that the width of the recesses (288) transverse to their axial direction corresponds to the diameter of the pins (286) penetrating into these.

23. A functional element for attaching, in particular, but not exclusively, for attachment in a liquid-tight or gas-tight manner, to a sheet metal part, in particular in accordance with a method in accordance with any one of the claims 1 to 12 and/or using a die in accordance with at least one of the claims 13 to 22, characterized in that the functional element 210 comprises a shaft part (210b) and a head

part (210a) designed for a riveted joint to a panel member, in particular to a sheet metal part (212) in that at least the head part (210a) is made hollow and preferably has at least substantially the same outer diameter as the shaft part (210b).

24. A functional element in accordance with claim 23, characterized in that the hollow head part (210a) has a preferably at least substantially partly spherical rounded shape (268) at its end remote from the shaft part, with said rounded shape ending in particular in an at least substantially circular aperture (270) at the end face which is preferably arranged in a plane perpendicular to the longitudinal axis (236) of the functional element.

25. A functional element in accordance with claim 23 or claim 24, characterized in that the open end face (271) of the element is rounded so as not to damage the component or the sheet metal part.

26. A functional element in accordance with claim 23 or claim 24, or claim 25, characterized in that the cylindrical side wall of the head part (210a) of the functional element is made compressible so that when the functional element is being attached, the wall can be deformed to form an undercut (326) into two radially outwardly projecting annular bulges or annular folds (320 and 322) spaced from one another.

27. A functional element in accordance with any one of the preceding claims, characterized in that the end face aperture (270) is provided with a wall tapering conically in the direction of the shaft part

(210b) with the included angle of the wall being in the region between 30° and 120°, preferably between 45° and 90°.

28. A functional element in accordance with any one of the preceding claims 23 to 27, characterized in that it is realized as a bolt element.

29. A functional element in accordance with any one of the preceding claims 23 to 27, characterized in that it is realized as a nut element.

30. A functional element in accordance with any one of the preceding claims 23 to 29, characterized in that it has been manufactured from a tube section by high-pressure forming.

31. A functional element in accordance with any one of the preceding claims 23 to 29, characterized in that it is manufactured from a tube section or from wire material or bar stock by a cold forming process.

32. A component assembly comprising at least one sheet metal part (212) and at least one functional element (210) in accordance with at least one of the claims 23 to 29, which is manufactured in accordance with a method in accordance with at least one of the claims 1 to 12 and/or using a die (214) in accordance with at least one of the claims 13 to 34, characterized in that a hollow head part (210a) of the functional element (210) is deformed to form two annular bulges (320, 322) projecting radially outwardly and spaced from one another and between which an undercut (324) is present in which the sheet metal material is received in a form-locked manner and in that

the sheet metal part (212) extends into the undercut (324) of the functional element (210).

33. A component assembly in accordance with claim 32, characterized in that the sheet metal part (212) is not perforated and not pierced at least in the region of the functional element (210), i.e. is of the joint to the functional element (210).

34. A component assembly in accordance with claim 32 or claim 33, characterized in that when a sheet metal part (212) having a coated surface is used, said surface is not damaged, at least at the side opposite the functional element (210), by the attaching of the functional element (210) to the sheet metal part (212).

35. A component assembly in accordance with at least one of the claims 32 to 34, characterized in that the head part (210a) of the functional element (210) is at least partly arranged in a pot-like recess of the sheet metal part (212).

36. A component assembly in accordance with any one of the preceding claims 32 to 35, characterized in that the head part is fully surrounded by the sheet metal part with the exception of the area adjacent to the shaft part (210b).

37. A component assembly in accordance with any one of the preceding claims 32 to 36, characterized in that the sheet metal material of the sheet metal part that protrudes into the undercut (329) is formed as an annular fold or an annular bulge (326).

38. A component assembly in accordance with any one of the preceding claims 32 to 37, characterized in that the base region of the sheet metal part (212) formed in a pot-like manner has a convex shape (212b) facing towards the shaft part of the functional element.

39. A component assembly in accordance with any one of the preceding claims 32 to 38, characterized in that the annular fold (322) of the head part (210a) of the functional element (210) adjacent to the base region is reformed into the corner region of the pot-like recess of the sheet metal part (212) which is being formed between the base region and the side wall of the pot-like recess.

40. A component assembly in accordance with any one of the preceding claims 32 to 39, characterized in that the sheet metal part has oblique noses (334) extending in the radial direction and spaced from one another in the region where the pot-like recess merges into the general plane of the sheet metal part (212), with said noses (334) forming channels on the side adjacent to the sheet metal part, and in that the upper annular bulge (320) has corresponding noses which engage inside the channels with the noses (334) of the sheet metal part in a form-locked manner for the security against rotation.

41. A plunger arrangement in conjunction with a die in accordance with any one of claims 13 to 22 for use with a functional element (210) with a shaft part (210b) having shaped features and with a head part (210a), in particular a functional element in accordance with any one of the claims 23 to 31, characterized by

- an outer plunger (403);
- an inner plunger (404) which is displaceably arranged with respect to the outer plunger within a plunger passage (402) of the outer plunger between a receiving position for the functional element (210) and an insertion position for the functional element (210), with the functional element (210) being able to be inserted into the plunger passage (402), preferably from the side, when in the receiving position, and with the head part (210a) of the functional element projecting out of the plunger arrangement (400) when in the insertion position; and
- by at least two segments (426) supported by the outer plunger which preferably have shaped features (432) at an inner side (430) which can engage into the shaped features of the shaft part (210b) of the functional element and which are movable between an open position (Fig. 6B) remote from the shaft part (210b) of the functional element and a closed position (Fig. 6C) in engagement with the shaped features of the shaft part (210b).

42. A plunger arrangement in accordance with claim 41, characterized in that the outer plunger has an upper part (414) and a lower part (412) fixed to the upper part, with a conical recess (420) arranged concentrically to the longitudinal axis (405) of the die being provided in the lower part (412) and the segments (426) having corresponding conical faces (442); in that the segments are upwardly biased in the direction of the upper part (414), against said upper part (414), by spring-biased tappets (448) preferably set obliquely to the longitudinal axis (405) of the plunger arrangement, with their shaped features (432) in this position being able to engage in those (211) of the

functional element (210) urged forwardly under the pressure of the inner plunger (404); and in that the tappets (448) can be displaced back by means of a drawing force exerted on the functional element and drawing it out of the plunger passage and the segments and can move against the conical recess (420) of the lower part and thus into the open position to release the functional element.

43. A plunger arrangement in accordance with claim 42, characterized in that the upper part (414) of the outer plunger (403) has a conical recess (422) to center the segments and which is likewise arranged concentrically to the longitudinal axis (405) of the die and in that the segments (426) have further conical faces (438) which come into engagement with said conical recess (422) in the closed position.